What is claimed is:

1. A band filter for filtering an optical signal having components in one or more passbands of the filter, comprising:

a first waveguide grating router;

a second waveguide grating router; and

a plurality of waveguides connecting the first waveguide grating router to the second waveguide grating router, the plurality of waveguides arranged as a waveguide grating, each waveguide having a center wavelength for supporting transmission of an optical signal;

wherein the plurality of waveguides is partitioned into at least two sets of waveguides, each set of waveguides corresponding to a particular passband in the band filter, the waveguides in a set having unequal path lengths, and the adjacent waveguides within each set having a path-length difference related to a non-zero integer multiple of a wavelength located between the center wavelengths of the adjacent waveguides.

2. The band filter as defined in claim 1 wherein said band filter includes one input port and at least two output ports, the number of output ports corresponding to the number of waveguide sets, said input port disposed on an input side of the first waveguide grating router for receiving said optical signal comprising a plurality of optical channels, and said output ports disposed on an output side of the second waveguide grating router for outputting at least one channel of the optical signal from each output port.

3. The band filter as defined in claim 2 wherein said optical signal comprising a plurality of optical channels is a coarse wavelength division multiplexed signal.

4. The band filter as defined in claim 1 wherein said band filter includes at least two input ports and one output port, the number of input ports corresponding to the number of waveguide sets, said input ports disposed on an input side of the second waveguide grating router each for receiving said

optical signal comprised of one or more of optical channels, and said output port disposed on an output side of the first waveguide grating router for outputting substantially all the optical channels carried by said optical signals in a wavelength division multiplexed format.

5. The band filter as defined in claim 4 wherein said wavelength division multiplexed format is a coarse wavelength division multiplexed format.

6. A band filter for filtering an optical signal having components in one or more passbands of the filter, comprising:

a first waveguide grating router;

a second waveguide grating router; and

a plurality of waveguides connecting the first waveguide grating router to the second waveguide grating router, the plurality of waveguides arranged as a waveguide grating, each waveguide having a center wavelength for supporting transmission of an optical signal;

wherein the plurality of waveguides is partitioned into at least two sets of waveguides, each set of waveguides corresponding to a particular passband in the band filter, the waveguides in a set having unequal path lengths, and the adjacent waveguides having a path-length difference defined as:

$$L(m) - L(m-1) = \frac{A_{\text{middle}}}{2n}\left[\lambda(m) + \lambda(m-1)\right]$$

where $L(m)$ is the path length of waveguide m, $\lambda(m)$ is the center wavelength supported for propagation by waveguide m, n is the waveguide refractive index, and A_{middle} is an integer grating order of the waveguide grating, where A_{middle} is chosen to be greater than or equal to order 5.

7. The band filter as defined in claim 6 wherein the first waveguide grating router includes a second waveguide grating of order A_{left} comprising M_{left} waveguides, wherein the second waveguide grating router includes a third waveguide grating of order A_{right} comprising M_{right} waveguides, and wherein A_{middle} is chosen to be less than one of either $A_{\text{left}}M_{\text{left}}/25$ or $A_{\text{right}}M_{\text{right}}/25$.

8. The band filter as defined in claim 7 wherein said band filter includes one input port and at least two output ports, the number of output ports corresponding to the number of waveguide sets, said input port disposed on an input side of the first waveguide grating router for receiving said optical signal comprising a plurality of optical channels, and said output ports disposed on an output side of the second waveguide grating router for outputting at least one channel of the optical signal from each output port.

9. The band filter as defined in claim 8 wherein said optical signal comprising a plurality of optical channels is a coarse wavelength division multiplexed signal.

10. The band filter as defined in claim 7 wherein said band filter includes at least two input ports and one output port, the number of input ports corresponding to the number of waveguide sets, said input ports disposed on an input side of the second waveguide grating router each for receiving said optical signal comprised of one or more of optical channels, and said output port disposed on an output side of the first waveguide grating router for outputting substantially all the optical channels carried by said optical signals in a wavelength division multiplexed format.

11. The band filter as defined in claim 10 wherein said wavelength division multiplexed format is a coarse wavelength division multiplexed format.

12. The band filter as defined in claim 1 wherein the waveguide grating, within each set of waveguides, has a grating order greater than or equal to 5 and wherein the plurality of waveguides in the waveguide grating traverse a substantially parabolic shape.

13. The band filter as defined in claim 12 wherein at least one of said at least two sets of waveguides exhibits a grating order that is different from the grating order from another one of the at least two sets of waveguides.

14. The band filter as defined in claim 6 wherein the plurality of waveguides in the waveguide grating traverse a substantially parabolic shape.

15. The band filter as defined in claim 14 wherein at least one of said at least two sets of waveguides exhibits a grating order that is different from the grating order from another one of the at least two sets of waveguides.

16. The band filter as defined in claim 1 wherein the path-length difference is substantially related to a non-zero integer multiple of an average of the center wavelengths corresponding to the adjacent waveguides.

17. The band filter as defined in claim 1 wherein the path-length difference is substantially equal to a non-zero integer multiple of an average of the center wavelengths corresponding to the adjacent waveguides, said average further divided by a refractive index representative of said adjacent waveguides.

18. A band filter for filtering an optical signal having components in one or more passbands of the filter, comprising:

first means responsive to the optical signal for demultiplexing the optical signal into a plurality of first optical bands;

second means coupled an output side of the first means for supporting optical transmission of the plurality of first optical bands individually on a corresponding plurality of optical paths therein, the second means arranged to group adjacent optical paths in said plurality of optical paths together to form a plurality of groups of optical paths, said plurality of optical paths being larger in number than said plurality of groups of optical paths; and

third means coupled to the second means opposite to receive said plurality of groups of optical paths for multiplexing the first optical bands in each said group together so that each group of said first optical bands is output individually by the third means within a second optical band substantially equal to a sum of the first optical bands in the group;

wherein the optical paths within a group having unequal path lengths, and the adjacent optical paths having a path-length difference defined as:

$$L(m) - L(m-1) = \frac{A_{\text{middle}}}{2n}\left[\lambda(m) + \lambda(m-1)\right]$$

where *L(m)* is the path length of optical path *m*, *λ(m)* is the center wavelength supported for propagation by optical path *m*, *n* is the refractive index for the optical paths, and A_{middle} is an integer, where A_{middle} is chosen to be greater than or equal to 5.